

CHAPTER 5. SHELLFISH

5.1. *Soft shell Clams*

The soft shell clam is the most important fishery in Plum Island Sound. The financial impact of this bivalve can be felt along many economic lines; from the harvesters to the distributors, from the processors to the restaurant owners. The industry is powerfully influenced by a variety of external factors which effect the productivity of this fishery. Pollution, over-harvesting, and predation are the main issues facing the fishery. Balancing these influences with economic need is critical to the long-term sustainability of the resource and the industry that depends on it.

The shellfish resources of the estuary have not been inventoried in the field since the 1968 monograph. For purposes of updating shellfish data, shell fishermen in the region were interviewed, town harvest and license statistics were compiled, and published and unpublished reports were reviewed. Harvest statistics, which are submitted to the Division of Marine Fisheries (DMF) from the individual towns, were also reviewed. Shell fishermen estimated current shellfish population locations and the relative productivity of these areas. Although this report is primarily concerned with the soft shell clam, *Mya arenaria*, information on surf clams, *Spisula solidissima*, quahogs, *Mercenaria mercenaria*, and American oysters, *Crassostrea virginica*, is also included. The location of productive mussel (*Mytilus edulis*) beds, razor clams (*Ensis directus*), and lobstering (*Homarus americanus*) areas have been documented as well.

5.1.1. Historical Background

The early history of the soft shell clam industry in Massachusetts was described well by Belding (1930) as cited by Jerome et al. (1968). Belding stated that this clam was a vital resource for Native Americans and vital to the commercial fisheries as a means of bait, in the eighteenth and nineteenth century. Felt (1834) reported that a sizable bait industry was thriving in Ipswich in 1789 when 1,000 barrels of clams were dug annually and sold in Boston and elsewhere for \$5 to \$6 a barrel. An estimated \$27,000 worth of clams were dug in Ipswich in 1866 (*Ipswich Bulletin*, June 7, 1867). In 1867, Ipswich clammers were earning from \$3 to \$6 a day as a result of their efforts.

Belding documented that in 1875, the local consumption of the clam became popular, and subsequent years saw a rapid decline in the resource due to a lack of harvesting controls. However, Felt attested to some historical attempts to control harvesting, specifically, "The commoners forbid any more clams to be dug than are necessary for the use of people in the Town, and of fishing vessels. They allow one barrel for each of a crew to the banks, and in proportion for boats in the bay." A law that prohibited clamming on Sunday was passed in Ipswich in 1883. Over-harvesting was undoubtedly a result of an initial philosophy that the resource was inexhaustible.

Clamming boomed in Plum Island Sound during the early 1920's when other shellfishing areas were struggling with pollution problems. In 1927 for example, 47,550 barrels of whole clams were reported harvested and of that 35,225 gallons of shucked clams were registered (Jerome et al., 1968).

Pollution has been a significant constraint on shellfishing in the Sound. In 1928 and 1929, many of the Ipswich shellfish flats, including all of the Ipswich River, were closed by the Massachusetts Department of Public Health because of pollution. An estimated \$50,000 and \$70,000 was lost in 1930 due to the closure (Annual Report, Ipswich, 1930). The same report emphasized the impact of the closure stating that, "it was probable that nearly one-fifth of the people of the town are dependent on the clam flats. A barrel of clams may bring into Ipswich anywhere from \$6.00 to \$30.00." In 1931, clamming in Ipswich provided more employment and revenue than any other business. By 1937, the Ipswich shellfish industry was estimated to be worth \$200,000 and had a potential value of \$500,000 to \$1,000,000. In 1939, the soft shell clam industry in Rowley provided an income of approximately \$75,000 to the residents of the town (Jerome et al., 1968).

On May 11, 1945, the *Ipswich News and Chronicle* reported that the flats of Treadwell Island and Fox Creek were declared open by the Massachusetts Department of Public Health. At that time, the soft shell clam industry in Ipswich was in poor condition. The Ipswich Annual Report (1945) listed the following causative factors: clam flats invaded by mussels, sea gulls feeding on small clams, the large numbers of nonresidents digging the flats and the need for new regulations. The Ipswich Annual Report (1947) stated, "the clam industry is at its lowest ebb since 1932" (Jerome et al., 1968). Unfortunately, the opening of the Treadwell and Fox Creek flats lasted only a short time due to pollution problems.

Since 1950, landings have varied greatly from year to year, and from town to town. Flats today are more closely regulated and monitored, although shell fishermen still complain of over harvesting and problems with flat productivity. Brousseau (2001) noted that based on the available data, there is no evidence that soft shell clams are being over harvested in the region, however she qualified this by noting a lack of rigor in the collection of harvest statistics. On a positive note, after much effort by the town of Ipswich to clean up pollution sources, the flats of Treadwell Island and Fox Creek were reopened conditionally in 1999. According to Jeff Kennedy of DMF, the soft shell clam from Plum Island Sound, although a fragile resource, still has a national reputation for quality.

5.1.2. A Brief Life History

Soft shell clams inhabit the intertidal flats of estuaries. Like many estuarine organisms, they can tolerate a wide range of temperatures and salinities. In Plum Island Sound the clams inhabit soft sediments where salinities are typically around 30 ppt. Those that inhabit the midpoint between high and low water tend to grow the fastest, consequently this is the region where they are most often harvested. The depth to which they burrow depends on the substrate and the size of the clam.

In general, the substrate composition of Plum Island Sound intertidal clam flats is primarily sand and a sand-silt mixture. Sand is found in areas exposed to strong tidal currents and wave action, and in areas having good subsurface drainage. Sandy muds are found in rivers, creeks, and areas where tidal currents are more restricted. According to Jack Grundstrom, a long-time clammer in Rowley, sand flats are generally less productive than mudflats.

Clams in the region spawn primarily in the summer, and the larvae then drift with the plankton for several weeks (Brousseau, 1999). Those that survive eventually settle to an appropriate substrate, sometimes at a considerable distance from the parent clams. Like many marine animals with planktonic larvae, larval mortality of soft shell clams is high. In addition, recently settled juveniles are susceptible to predation from crabs and other animals as well as mortality from abiotic factors (e.g., low dissolved oxygen, temperature fluctuations). As a result, soft shell clams show tremendous annual variation in recruitment success. As they grow and are able to burrow deeper into the substrate, predation intensity declines. Soft shell clams take two years to reach sexual maturity. At that point they are roughly at the legal minimum size for harvest, which is 51 mm. They can live from 10-12 years.

5.1.3. Aquaculture

Continuing efforts have been made since the 1930's to improve and protect the soft shell clam resources in Ipswich and Rowley by seeding barren flats, removing mussels and controlling predator populations, i.e., green crabs, horseshoe crabs, and moon snails). In 1939, over 440 barrels of seed clams were planted in Ipswich and 120 barrels in Rowley. Twenty-five bushels of seed were transplanted in Ipswich in 1964. Recent experimental efforts by the Merrimack Valley Planning Commission (MVPC) in partnership with local clammers have resulted in small scale restoration of shellfish beds in the Town of Ipswich and Gloucester. MVPC identified flats that were deemed consistently under-productive but appeared suitable for aquaculture. These flats included an area in the Eagle Hill River, portions of Paine Creek, and the south side of the Rowley River. MVPC calculated that these flats could yield approximately 7,000 bushels per year (MVPC, 1997). In 1995 and 1996 MVPC established test plots on the Eagle River Flat (50 12'x12' and 4 12'x50' plots - total area of approximately one acre). These plots were staked and some were netted with polypropylene. The preliminary results of these test plots were encouraging: a survival rate of approximately 55% over two growing seasons. In 1996 the survival rate was calculated to be over 90% (MVPC, 1997).

In Rowley the MVPC identified the Nelson Island Bank as having potential to yield a harvest of \$125,000 annually. Currently the flat is considered under productive (MVPC, 1997).

The potential for privately run aquaculture is a source of tension within the clamming community. Some clammers and town officials feel that private leases would take away areas of clamming from the general public, others have embraced the concept of private aquaculture, at least in Ipswich (W. Castonguay, pers. comm). One way to address this concern is to have public aquaculture projects that are carried out with the cooperation of town officials and the clamming community (MVPC, 1997). In reality, since all flats within the Sound, excluding the

prohibited Ipswich and Parker River flats, are classified as conditionally approved, and DMF allows private aquaculture only on areas approved unconditionally (i.e. areas that are free from pollution even during heavy rain), completely private aquaculture projects are not possible in Plum Island Sound at this time. Public aquaculture projects on the other hand, are permitted on conditionally approved flats. As a result there is an opportunity for towns to partner with technical organizations to develop aquaculture projects.

5.1.4. Predators of Soft shell Clams

The major predators of soft shell clams have changed over time depending on the relative abundance of each predator species over the years. Moon snails, *Lunatia heros*, locally called cockles, are commonly seen on many of the Plum Island Sound flats. Their presence is marked by drill holes in the shell of the soft shell clam (Jerome et al., 1968). In Newbury there was concern over the abundance of moon snails in the Plum Island River East Flats in 1965, but the productivity of this region is currently fine. Efforts to destroy moon snails have been loosely organized in Rowley in the past years, and the success of these efforts is unknown.

Horseshoe crabs, *Limulus polyphemus*, are also common in the Sound, and their feeding activities are noted by the presence of puddling in the exposed mud flat. In 1949, over 32,000 horseshoe crabs were reportedly destroyed in Ipswich because they were considered a serious menace to soft shell clam seed populations. Horseshoe crabs were so abundant at that time that planting seed clams was deemed inadvisable (Jerome et al., 1968).

In the fall of 1938, vast numbers of green crabs appeared in the estuary. WPA projects were initiated in Ipswich and Rowley to protect soft shell clam resources from this predator. Over 2,500 bushels of green crabs were destroyed in Ipswich in 1939. By 1940, it was reported that the numbers of green crabs had been drastically reduced. In Rowley, the reduction in numbers was estimated at 90 percent (Jerome et al., 1968). In 1992 the town of Ipswich attempted to deter the green crab population by initiating a trapping program. 1/2" wire traps, 12" square and 24" long were used and set on the small clam flats on the Eagle Hill River and other small tributaries (this was also done for harvesting bait for the sport fishery). The traps were quite effective but there were no scientific studies to determine what effect it had the soft shell clam population. It was discontinued because of a lack of a sustainable commercial market. In Ipswich, the MVPC in the establishment of aquaculture sites in the Eagle Hill River identified the green crab as the main predator of the soft shell clam (MVPC, 1997).

In 1965 predation by the green crab, *Carcinus maenas*, was not indicated as a major threat to the soft shell clam (Jerome et al., 1968). Today, its abundance makes it a concern to clammers throughout the region. The amount of predation by the green crab is likely influenced by the abundance of striped bass and gulls, which feed on the crab. According to Wayne Castonguay (Ipswich Shellfish Advisory Board) green crabs are now considered major predators capable of wiping out entire shellfish beds (pers. comm.).

Mussels occasionally compete with clams for space on the flats. They were considered a serious problem by Ipswich clammers in 1944 when one-fifth of the flats were covered with

mussels. By 1946, mussels had taken over one-third of the best soft shell clam producing habitat. A barge was purchased in 1948, rigged as a dragger, and utilized for mussel control work. During that year, 750 tons of mussels were removed and destroyed. Another 650 tons were removed in 1949. Mussel control continued to be an important phase of the Ipswich shellfish management program as evidenced by the windrows of mussels gathered and piled on the flats of Grape Island in 1965 (Jerome et al., 1968). Presently mussel replacement is not of grave concern to local clambers.

Bird predation of soft shell clams has not been quantified. The herring gull, *Larus argentatus*, and the great black-backed gull, *Larus marinus*, have been observed feeding on soft shell clams exposed on the flats by diggers. Undersized clams turned up by the diggers during the harvesting process are especially susceptible to predation. Gulls also feed on green crabs, so their net effect on clams is difficult to evaluate.

In addition to gulls, the estuary is heavily utilized by waterfowl. The most important species in relation to shellfish, in terms of abundance and feeding habits, is the black duck, *Anas rubripes*. Locally, in the fall and winter of 1967, the black duck reached a peak population of approximately 20,000 individuals (unpublished data from the U. S. Fish and Wildlife Service, Parker River National Wildlife Refuge, 1967). Maximum counts in the early 1990s were about 1500 (See Table 6.1). This species uses the salt marshes, tidal creeks and clam flats of the study area and the Merrimack River estuary for food and cover. The actual amount of predation damage caused by this species is not known, but evidence points to some feeding on seed clams that are found on or near the surface of the flats. Black duck numbers have declined overall in the east coast and in Plum Island Sound since the 1950s so predation by this duck is likely less of a factor now than in the past.

5.1.5. Licensing

The number of shellfish permits issued has varied greatly throughout the years. In many cases, it is not known whether the permits were sold for commercial or non-commercial purposes. In 1922, 47 permits were issued in Ipswich. Of the 300 permits issued in 1935, 250 were held by "regular diggers" and the remaining 50 by "transients" (Ipswich Annual Report, 1935). As a result of the manpower shortage brought about by World War II, only 40 men were reported digging in 1942. During the period of 1956 -1964, excluding 1960, the average of commercial permits for the Town of Ipswich was 93 and for non-commercial permits it was 1,585 (Jerome et al., 1968). In recent years, however, more complete records have been compiled in the Towns of Ipswich, Newbury and Rowley (Table 5.1).

In addition to the commercial harvest, substantial numbers of individuals harvest shellfish from local flats for their own personal use. A breakdown of the total permits issued in Rowley in 1997 indicate the following: 38% were from resident recreational diggers, 10% were from non-resident recreational diggers, 5% were one day non-resident permits and 16% were issued to diggers over 60. Commercial permits were 31% of the total permits issued in 1997 for the Town of Rowley.

Recreational permits issued in Newbury and Rowley are almost exclusively used to gather soft shell clams, while those in Ipswich included both soft shelled and surf clams (EOEA, 1996).

Table 5.1. Commercial Licenses Issued for Shellfishing (From Town Records).

Year	Newbury*	Rowley **	Ipswich
1994	102	20	111
1995	88	16	120
1996	94	35	160
1997	84	52	186
1998	85	65	206
1999	87	37	153
2000	74	26	125

* Includes senior and minor commercial licenses

** Defined by fiscal year

Table 5.2. Recreational Licenses Issued for Shellfishing (Does not include non resident recreational licenses, licenses issued for over 60 years of age and one day non-resident and resident permits).

Year	Newbury	Rowley*	Ipswich**
1994	54	33	228
1995	70	41	278
1996	58	65	299
1997	68	62	319
1998	74	45	282
1999	77	41	312
2000	55	46	252

* Defined by Fiscal Year

** Includes Family and Resident Permits

5.1.6. Associated Fauna

Several species of larger marine invertebrates are commonly found in the tidal flats along with the soft shell clam. They include the blue mussel, *Mytilus edulis*; duck clam, *Macoma balthica*; false angel wing, *Petricola pholadiformis*; razor clam, *Ensis directus*; ribbed pod shell, *Siliqua costata*; northern moon snail, *Polinices heros*; clam worm, *Nereis virens*; and bloodworm, *Glycera dibranchiata*.

5.1.7. Mortality of Shellfish on the Flats

No evidence of catastrophic shellfish mortality was observed or reported in the flats of

Ipswich or in the estuary as a whole during 1990s. In the late 1960s, however, Arthur Moon, Ipswich Shellfish Constable, reported that high mortality rates were noted on some Ipswich flats. This was attributed to the accumulation of excessive amounts of a marine algae, *Enteromorpha sp.* In 1997, neither Verne Noyes, Newbury Shellfish Constable nor Philip Kent the Ipswich Shellfish Constable, could recollect any significant soft shell clam mortality events in recent years.

5.1.8. Pollution

The National Shellfish Sanitation Program (NSSP) was established in response to increased concern about the human health risks associated with bacteria contamination. The NSSP requires Massachusetts to regularly test water in shellfish growing areas and to classify them according to standards set to protect human health (I.S.S.C., 1988). The Massachusetts Division of Marine Fisheries (DMF) monitors Plum Island Sound and other coastal waters and classifies them based on fecal coliform bacterial levels. Each area has a sanitary classification (Table 5.3) and a status that indicates if an area is open or closed.

In 1996, all shellfish areas in the main section of the Sound were “conditionally approved”, which means that the flats are closed for five days if rainfall levels exceed a minimum of 0.5 inches in a 24 hour period. If more than one inch of rain falls the flats are closed for at least eight days. In such cases, a short-term assessment may extend the time of closure. A specific area may be closed if bacteria levels rise in dry weather. If this condition persists, the sanitary classification might change from “conditionally approved” to “prohibited.” Some areas are “seasonally approved”; for these areas closure may occur in the summer when bacteria counts generally rise.

In 1996 the “conditionally approved” acreage in Plum Island Sound, not counting the Ipswich River estuary, included 3,484.92 open and 349.47 closed acres (Table 5.3). This classification system, based on a draft report of the Parker River Watershed Team, includes open water as well as shellfish beds, so it overestimates the percentages of open areas that actually contain shellfish (EOEA, 1996).

For much of the past century, all of the 180 acres of intertidal shellfish beds in the Ipswich River estuary were classified as “prohibited” for shell fishing because of chronic high levels of fecal coliform bacteria. In a very positive step mentioned above, those at Treadwells Island and Fox Creek were reclassified as “conditionally open” to harvesting in 1999. In 1965 out of a total acreage of clam flats estimated at that time of 755 acres, 574.3 acres (68.6%) were

Table 5.3. CLASSIFICATIONS OF SHELLFISH BEDS IN MASSACHUSETTS.
Adapted from the Massachusetts Division of Marine Fisheries, Shellfish Sanitation Program (I.S.S.C., 1988).

<p>Approved: Suitable for human consumption. Sanitary surveys complete, monitoring indicates low levels of fecal coliform bacteria averaging less than 14 fecal coliforms bacteria per 100 ml of seawater with no more than 10 percent of the samples higher than 43.</p>
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Seasonally Approved: Approved for shellfishing, except during a certain season. Most seasonally approved shellfish beds are closed during the summer because of higher human activity from summer residents and tourists. Suitable for human consumption during approved periods.

Conditionally Approved: Approved for shellfishing, except during intermittent and predictable pollution events such as rainfall or sewage system overflows. These beds require detailed water quality monitoring during rainfall events. Shellfish are suitable for human consumption during approved periods.

Conditionally Restricted (soft-shelled clams): Areas that are affected by intermittent and predictable pollution events, and meet "restricted" area criteria when a pollution event is not occurring. Fecal coliforms concentrations averaging between 14 to 88 per 100 ml seawater with no more than 10% of the samples greater than 260. Beds are closed after a rainfall of 0.5 inches or more. Shellfish harvested from conditionally restricted areas are not suitable for direct consumption and must be either relayed to an approved area or to a shellfish purification facility and allowed to purge themselves of the pollution over time. These shellfish must be closely monitored and determined to meet strict sanitary standards prior to being marketed for consumption. Shellfish in restricted or conditionally restricted areas can only be harvested by specially licensed commercial diggers; recreational harvesting is not allowed.

Restricted: Averaging between 18 and 88 fecal coliforms per 100 ml seawater with no more than 10% of the samples greater than 260. No rainfall component. Hard shelled clams and other species must be relayed to clean water before harvesting. Not suitable for direct human consumption.

Prohibited/Restricted: Closed due to fecal coliform levels consistently exceeding 80 fecal coliforms per 100 ml seawater. Not suitable for human consumption.

Management Closure: Closed because no sanitary survey was performed by local officials due to lack of manpower, knowledge that the area is unproductive for shellfish, or an assumption that the area is grossly contaminated. These areas are not sufficiently monitored to meet NSSP guidelines. Faced with limited resources, shellfish officials often decide that their first priority is to keep clean beds open rather than address existing pollution.

classified as clean, 124.4 acres (21.7%) were grossly contaminated, and 55.9 (9.7 %) were classified as moderately contaminated. In 1997 before the opening of the Treadwells Island and Fox Creek flats, the total acreage of intertidal flats in Ipswich was estimated as 693 acres, of which 435 (62%) acres were “conditionally approved”, 180 acres (26%) were “prohibited” and 78 acres (12%) were “seasonally closed” (MVPC, 1997). Thus, the percentages of contaminated flats has stayed roughly the same in the past 30 years in Ipswich.

Table 5.4. Classifications for Shellfish Areas in Plum Island Sound, Jan 1, 1996 (EOEA, 1996). These figures include open water as well as harvestable areas.

Town/Area	Classification	Status	Acres
Ipswich/Plum Island Sound	Conditionally Approved	Open	1,894.65
Ipswich/Upper Rowley River	Conditionally Approved	Open	23.02
Newbury/Plum Island Sound	Conditionally Approved	Open	640.82
Newbury/Lower Parker River	Conditionally Approved	Closed	160.87
Newbury/Mill River	Conditionally Approved	Closed	159.47
Rowley/Plum Island Sound	Conditionally Approved	Open	920.11
Rowley/Mill River	Conditionally Approved	Closed	29.13
Rowley/Upper Rowley River	Conditionally Approved	Open	6.32

Plum Island Sound is located between the Ipswich and the Merrimack river watersheds, both of which are plagued by pollution problems that affect the Sound at its margins. A 1991 estimate of the economic loss due to the closure of the Ipswich River clam beds was \$ 500,000 (Castonguay, 1991). At the Merrimack River end, Newbury clammers have expressed concern that the proposed dredging of the Plum Island River will change the hydrology of the Sound. The fear is that dredging will allow more contaminated Merrimack River water into the upper portions of the Sound, resulting in more closed clam flats.

The extensive salt marshes of the study area likely act as a buffer between the coastal waters and the uplands. By filtering pollutants, the marshes may mitigate to some extent the impacts of shoreline development on water quality over the clam flats.

5.1.9. Soft Shell Clam Investigations - Town of Ipswich

5.1.9.1. General Description

The intertidal shellfish flats of Ipswich are located in Plum Island Sound, its tributaries including the Ipswich River estuary, and parts of Essex Bay (Fig. 5.1. and Fig. 5.2.). In 1965 the total soft shell clam habitat within the Plum Island Sound part of Ipswich was composed of 574.3 productive and 40.5 unproductive acres. In 1997 the acreage of intertidal flats was estimated at 693.

Ipswich is a major producer of clams in the region. The estimated total population of legal sized clams in the flats of Ipswich in 1965 was 78,648 bushels (Jerome et al., 1968). Between 1985 and 1996, landings ranged from about 5000 to greater than 20,000 bushels per year (Table 5.4). The relatively high harvest levels in 1985 and 1986 were a result of a temporary opening of flats within the Ipswich River estuary. This area was subsequently closed to shellfishing in 1986 due to pollution.

Table 5.5. Ipswich landings of soft shell clams in bushels. Numbers includes flats outside of Plum Island Sound and Ipswich River (e.g. Essex Bay) since the reports do not distinguish actual locations. Based on reports by the Ipswich Shellfish Constable submitted to DMF.

Year	Commercial Landings	Recreational Landings
1990	15,400	1,400
1991	16,957	1,550
1992	19,356	1,600
1993	9,533	1,725
1994	7,043	1,550
1995	12,594	1,475
1996	19,007	1,550
1997	25,284	1,900
1998	20,939	1,750
1999	19,577	1,875

Fig. 5.1. Marine Resources – Town of Ipswich (Ipswich River)

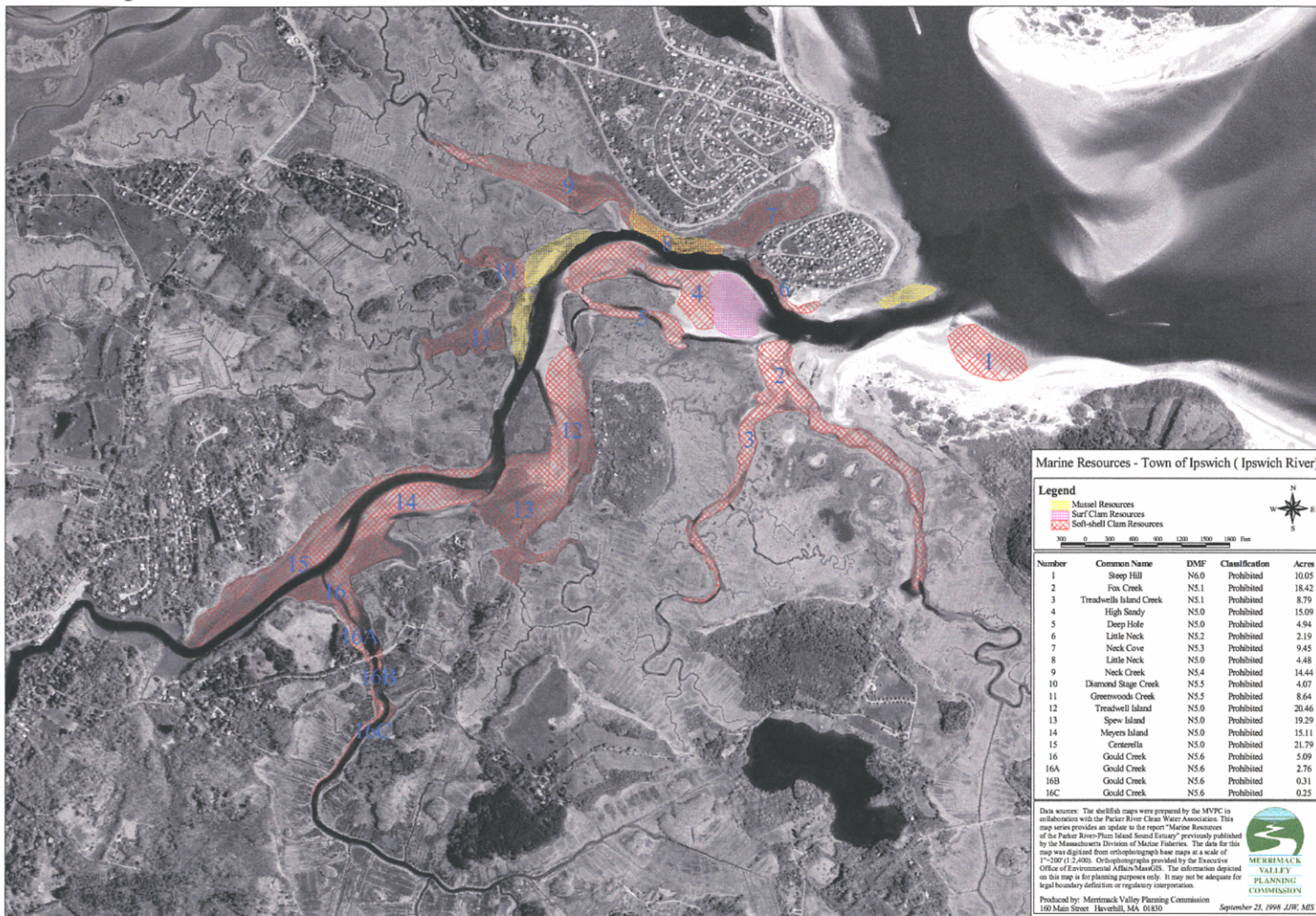
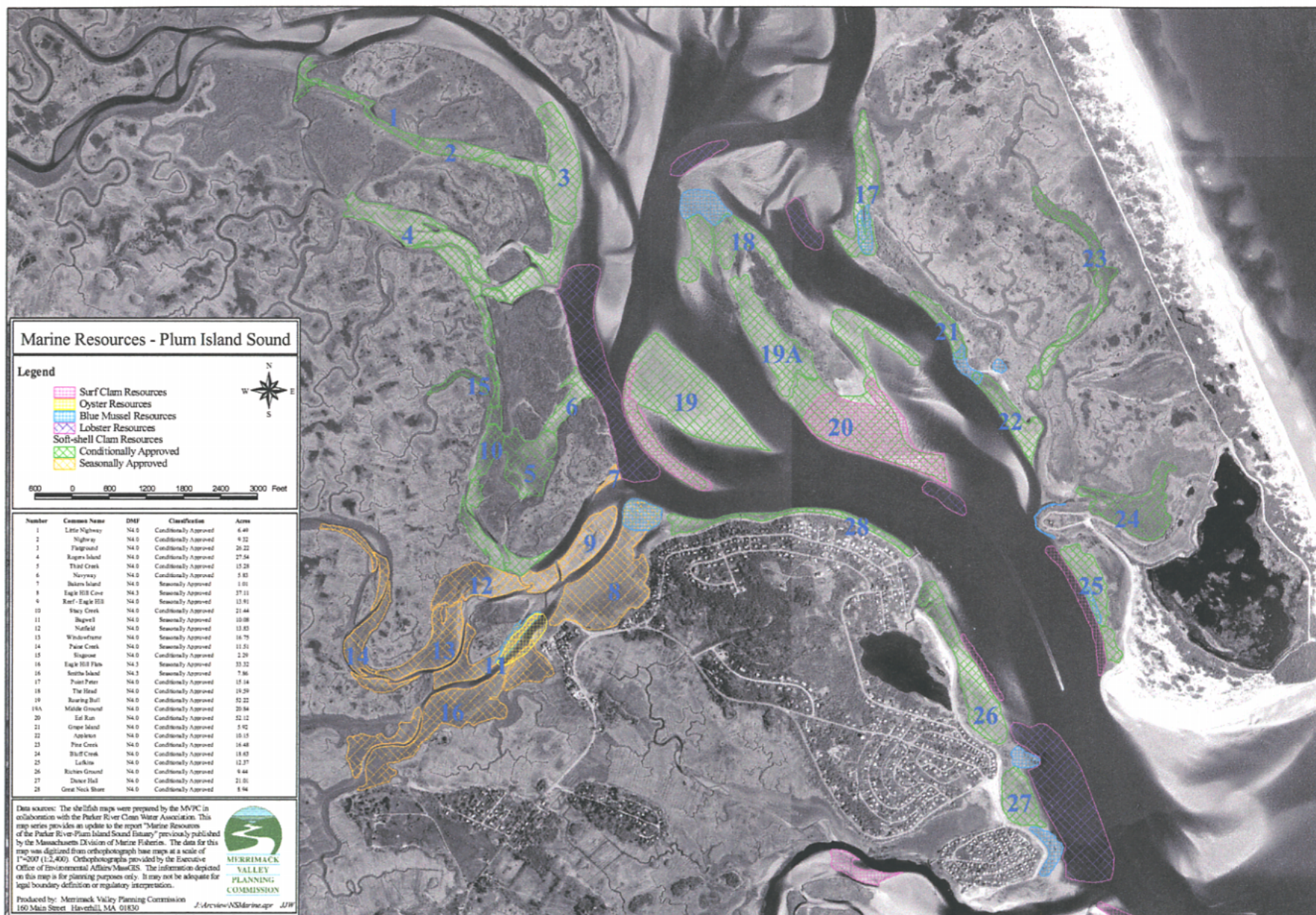


Fig. 5.2. Marine Resources – Town of Ipswich (Plum Island Sound)



Since the 1960s the productivity of the soft shell clam flats has been fairly good. New flats such as the productive Roaring Bull, which was not present in the 1968 study, have insured the stability of the clamming industry. One historic constant has been the closed status of Ipswich River flats for most of the past thirty years with the exception of 1985 and 1986 and the Fox Creek and Treadwells Island conditional openings starting in 1999.

Overall, the most productive flats have been Niaway, Third Creek, Rowley River, Stacey Creek, Roger Island River, Eagle Hill River, and Middle Ground, respectively. These flats are all located on the west side of Plum Island Sound, between the Eagle Hill and Rowley Rivers, where commercial digging was carried on intensively in 1965. Middle Ground had the largest acreage followed by Ipswich River South, Eagle Hill River, Ipswich River North, Fox and Treadwell Creeks, Roger Island River and Eagle Hill Cove. Today the largest flats and their associated acreage can be estimated from figures 5.1. and 5.2.

The estimated harvest of soft shell clams in Ipswich in 1965 by commercial and non-commercial diggers (30,000 bushels) had a wholesale value of approximately \$255,000 (\$8.50 per bushel, Jerome et al., 1968). Of the total bushels harvested in 1997 (14,069), the wholesale value (\$60.00/bushel) was approximately \$844,140. The price paid to diggers varied as multipliers increased the price per bushel cost.

5.1.10. Soft shell Clam Investigations - Town of Rowley

5.1.10.1. General Description

All of the intertidal shellfish flats in Rowley are located in Plum Island Sound and its tributaries (Fig. 5.3.). The Town of Rowley has approximately 950 acres of shellfishing areas and open water (MCZM 1996). All of the tidal waters and shellfish flats in Rowley were classified as clean and were open to the digging of shellfish by licensed digger in 1965. In 1996 most were classified as conditionally approved and some, such as the flats in the Mill River were closed due to high fecal coliform levels.

Rowley produces the least amount of soft shell clams of the three towns bordering the Sound. The estimated combined total population of legal sized clams in the flats of Rowley in 1965 was 3,707 bushels. From 1985 to 1996 landings ranged from 60 to 5,500 bushels (Table 5.6).

Fig. 5.3. Marine Resources – Town of Rowley

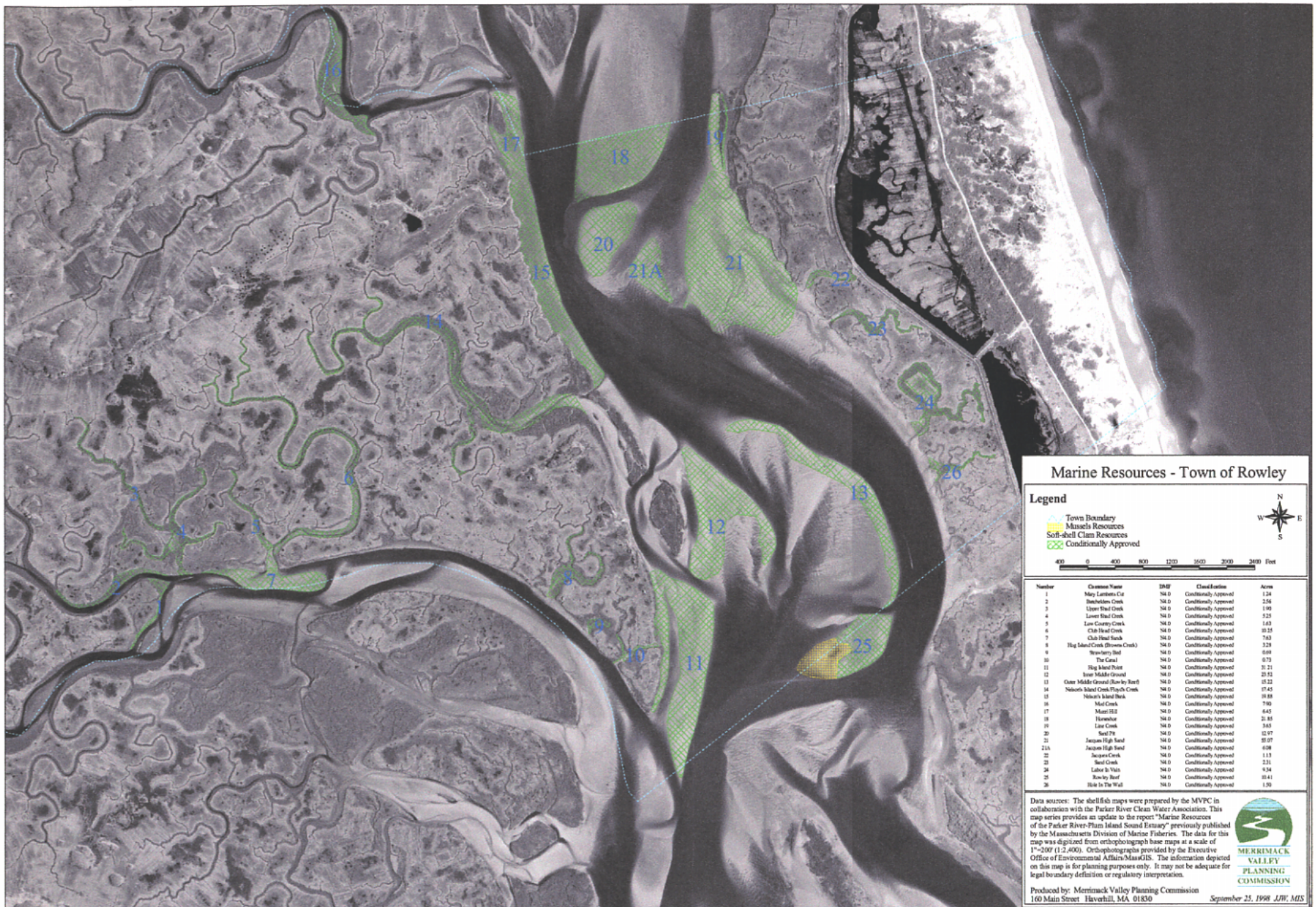


Table 5.6. Bushels of soft shell clams landed in Rowley, 1985-1994. Based on reports of Rowley shellfish constables submitted to DMF (no data submitted to DMF from 1995-2000).

Year	Commercial Landings	Recreational Landings
1985	240	18
1986	720	70
1987	60	50
1988	200	60
1989	5,500	610
1990	3,800	275
1991	No Report	No Report
1992	No Report	No Report
1993	1,400	120
1994	640	70

5.1.10.2. Discussion

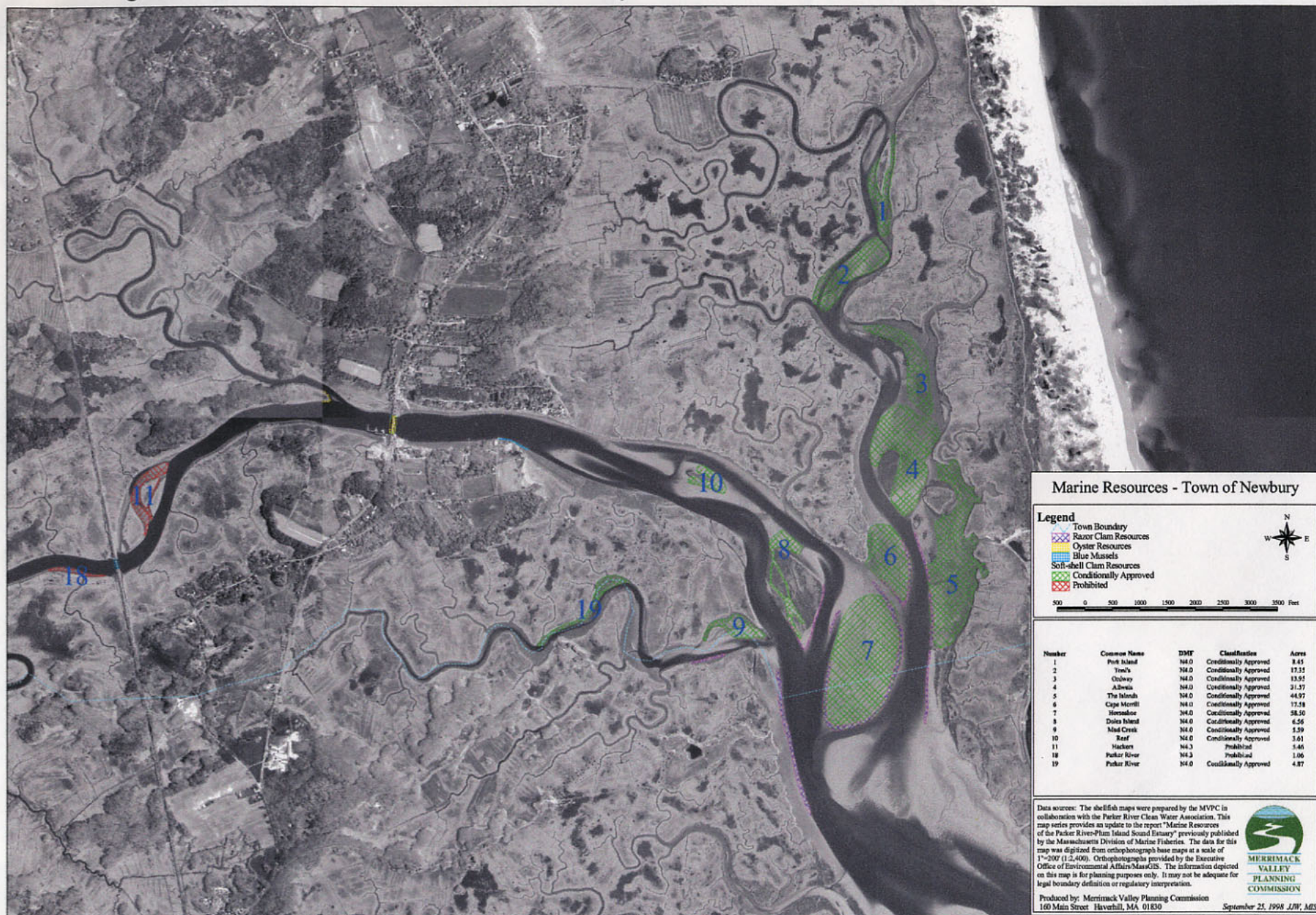
Rowley contained 47.7 acres of productive soft shell clam habitat in 1965 (Jerome et al., 1968). The commercial harvest of soft shell clams reported for Rowley in 1965 was estimated at 5,200 bushels, valued at approximately \$44,200. In 1985 the commercial harvest of soft shell clams was estimated at 240 bushels, valued at \$12,000. In 1965 Jerome et al. noted that the relatively small acreage of Rowley flats were under intensive use. Since 1985 the total bushels of commercial landings have not approached the 1965 harvest numbers (see Table 5.6).

5.1.11. Soft Shell Clam Investigations - Town of Newbury

5.1.11.1. General Description

The intertidal shellfish flats of Newbury contained within the study area are located in the Parker and Plum Island Rivers and in Plum Island Sound and its tributaries (Fig. 5.1). In 1965 all the tidal waters and shellfish flats in Newbury contained within the study area were classified as clean and were open to the taking of shellfish by diggers licensed by the Town of Newbury. In 2001, clamming was prohibited in the waters north of Pine Island Creek in the Plum Island River and in the Parker River west of Cottage Road due to poor water quality. The remainder of Newbury flats was conditionally approved.

Fig. 5.4. Marine Resources – Town of Newbury



Newbury rivals Ipswich in the amount of soft shell clams harvested and in some years the commercial landings exceed that of Ipswich. Between 1985 and 1996, landings ranged from 5000 to 8000 bushels (Table 5.7).

Table 5.7. Newbury Landings of Soft shell Clams in bushels. Based on reports of the Newbury Shellfish Constable submitted to DMF (no data submitted to DMF from 1997-2000).

Year	Commercial Landings	Recreational Landings
1985	6,000	745
1986	6,500	598
1987	5,590	269
1988	8,000	426
1989	5,000	1,149
1990	6,000	650
1991	6,772	788
1992	7,879	2,207
1993	5,927	287
1994	5,400	698
1995	6,890	562
1996	5,000	249

5.1.11.2. Discussion

Commercial diggers harvested approximately 1,680 bushels of soft shell clams in Newbury in 1965, valued at \$14,280. In 1985 the value of the commercial harvest of 6,000 bushels was \$276,420. From 1985-1994, the mean number of bushels of clams harvested by commercial diggers was 6,307. In 1994 Newbury was responsible for 41% of the total harvest of clams (5400 of 13,083 bushels) dug by commercial diggers in the Sound.

Most of the clams taken today in Newbury come from a variety of flats whereas in the late 1960's, the Ordway flat produced the most clams. Today the Ordway flat (36.4 acres), although still productive, is not the dominant clam producing flat.

5.2. Surf Clams

A recreational surf clam fishery exists and has existed in the subtidal portions of the lower estuary. The large clams are valued primarily for their use in chowders. Generally, the extreme low tides (neap tides) are considered best times to harvest the clam because the deeper portions of the beds are more accessible (Jerome et al., 1968).

The surf clam beds in the Sound are located mainly in Ipswich (Figs. 5.1. and 5.2). One of the largest beds is southeast of Middle Ground in Ipswich. According to shell fisherman Jack Grundstrom, the presence of surf clams in Rowley can be attributed to large storms that move the clams up the estuary into Rowley waters. In 1981, a peak year, Rowley recorded 50 bushels of surf clams (recreational and commercial) harvested valued at approximately \$1,500. Newbury has no surf clam harvest.

Ipswich recorded a total of 1,385 bushels of surf clams harvested from 1991 to 1999. These were recorded as recreational catches. Reporting is generally inconsistent.

5.3. Razor Clams

The razor clam harvest has become an important shellfish resource since the 1968 monograph. The bulk of the harvesting takes place in Ipswich. Reporting of the razor clam catch is not consistent annually, and peak harvests usually correspond to high market value. Razor calms are usually found at the lower margins of the soft shell clam flats, and are often dug at the neap tidal cycles. From 1990 to 1999, 15,965 bushels of razor clams were harvested commercially and 767 bushels were harvested recreationally in Ipswich. From 1990 to 1994, 223 bushels of razor clams were harvested commercially and four bushels were harvested recreationally in Newbury. In Rowley in 1990 and 1994, commercial and recreational diggers harvested 22 and 38 bushels respectively.

5.4. Oysters

Oysters were reportedly quite abundant in the estuary when the early settlers first arrived. Ewell (1904) says that, "As lately as 1840, Coffin tells us that there was not a day in the year in which the inmates of the Newbury almshouse, which was more recently the home of Mr. Alfred Ambrose, could not obtain oysters enough for their own use." [This is now the location of the Triton Regional School.] Today, as in 1965, oysters are known to be present in limited numbers in only a few locations. The locations correspond to rocky substrates where oysters cling. These oysters may be survivors of those planted in the estuary in 1950 (Table 5.8, Jerome et al., 1968).

Table 5.8. Oyster Stocking Records.

Annual Report	Quantity Planted	Location Planted
1938	16 bushels	Rowley River, Rowley
1950	50 bushels	Rowley
1950	50 bushels	Ipswich

Oysters were reportedly stocked in Newbury in 1950. One hundred bushels of adult oysters were planted in the Parker River, 50 bushels near the mouth of Little River and 50 bushels at a location approximately 200 yards east of the Route 1A bridge. In 1964 Division of Marine Fisheries personnel placed two strings of scallop shell cultch containing approximately 6,300 oyster spat beneath a float in Parker River near the Route 1A bridge. Two months later, on November 5, the average length of the spat had increased from 2.2 mm to 8.6 mm, a gain of 6.4 mm. Survival was estimated at 36.5 percent. The experiment was discontinued because of winter conditions. DMF reported in 1968, that the plantings were unsuccessful although today oysters were present just below the Route 1A bridge. The Route 1A site was reportedly used for many years by a Newburyport restaurant owner to store quantities of oysters until needed (Jerome et al., 1968). Today this area (west of Cottage Road) is closed to the harvesting of oysters.

According to the constable's reports the majority of the oyster harvest is recreational, and harvest totals vary considerably from year to year. From 1985-1996 the peak oyster harvest in Newbury was 300 bushels in 1989. In Ipswich 135 bushels were taken in 1990 (the peak harvest number from 1989-1999), and in Rowley there has been no recent recorded harvest.

5.5. Blue Mussels

The mussel harvest for the past decade has been sparse, and what data is available comes from constable reports. In Ipswich from 1990-1999 a total of 1,795 bushels of blue mussels were harvested. The peak year was 1991 when 330 bushels were harvested. These were recorded as recreational harvests. In Newbury and Rowley the mussel harvest in the past decade has totaled less than ten bushels.

5.6. Sea Worms, Family Nereidae and Family Glyceridea

Although the intertidal flats of the study area were used primarily for harvesting soft shell clams and other bivalves, they also can yield commercially viable blood and clam worms (sea worms) used for bait. Regulations governing worm digging and available harvest data

vary for each town.

According to the Jerome et al. (1968), 30 men dug clam and blood worms commercially for the bait industry in 1960. Each man averaged about 2,000 worms per day. In 1968, based on available statistics, the total estimated wholesale value of the commercial worm harvest within the study area was \$5,000. There are little data on the more recent harvests of sea worms. Boston Harbor and Salem Sound sustain a larger and more developed commercial harvest, possibly because they have substrates more favorable to these species (Castonguay, 1997).

5.7. American Lobster

Plum Island Sound contains a recreational fishery for lobsters. According to the 1968 study, lobstermen/women fished on a seasonal basis from about the 30th of May to the 30th of September, and most of the pots were fished singly. This still holds true today.

For purposes of this study a lobster pot marker survey was conducted on the 29th of August, 1997. Of the 224 pot markers within the Sound, most were clustered in the deepest portions of the Sound. The largest cluster, near the mouth of the Ipswich River, contained 56 pot markers. There were many areas of lone pot markers.

5.8. Green Crab

The green crab harvest in 1965, according to Marchant of the U. S. Bureau of Commercial Fisheries, Gloucester, Massachusetts, amounted to 9,300 pounds with a wholesale value of \$775. According to Wayne Castonquay, there is no current commercial green crab harvest, although there have been attempts at commercial harvesting, notably in the early 1990s by a Rowley based harvester. The green crab is primarily used as bait for the sport fish industry.

5.9. Quahogs

According to DMF reports the Town of Ipswich recorded 10 bushels of mixed quahogs harvested in 1968 and 1969. Quahogs are not typically found in the Sound as the northern extent of their range is considered Cape Cod. This harvest may be the result of a pro-active attempt to introduce the species to the Sound although there is no data to support this claim.

5.10. Summary

The soft shell clam fishery in the Parker River-Plum Island Sound estuary is by far the most valuable commercial fishery. In 1996 the commercial value of the soft shell clam harvest in Ipswich, Rowley, and Newbury was over one million dollars. The value of other marine

resources wax and wane, but none stands the test of time as well as this clam. There is a need for more rigorous data collection on soft shell clams.

More areas are now listed as closed to shellfishing than in the 1960s, most notably along the Parker River. Most of the Sound is classified as “conditionally approved” now as opposed to “approved” as it was in the 1960s. This may be due to more complete monitoring rather than an overall decline in water quality.

As in the 1960's, much of the contaminated acreage in the Sound is located in the Ipswich River and its tributaries. In 1999 some of these Ipswich River flats opened, illustrating the success of local pollution abatement efforts. The reopened flats provide renewed hope that more beds will open as pollution control efforts widen. Overall it is safe to say a burgeoning population, aging infrastructures and increase in impervious surfaces pose a measure of threat to the regions shellfish resources. It will therefore require constant vigilance and continued proactive efforts to maintain the health of the clam flats in the region.